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(54) Abstract Title
A digital broadcasting receiver and automatic channel searching method wherein channels are tuned sequentially effective channels being classified

(57) An automatic channel search method and a digital broadcasting receiver adopting the same are provided in which effective channels are more swiftly and reliably searched and channel configuration is performed with respect to each single network in a multi-network. At the time when a set is initially installed and then power is turned on, or a user selects an automatic channel searching mode in the case that a broadcasting service area is altered, the entire channels are sequentially tuned and effective channels are found based on the average of the signal intensity of each tuned channel and the error compensated state of the signal, to then be registered. Then, only the registered effective channels are sequentially tuned and a broadcasting signal of each tuned effective channel is parsed and classified into various necessary information. Thus, only the effective channels are parsed without parsing the entire channels, thereby saving unnecessary time, which provides an effect of swiftly processing a channel configuration of each single network with respect to a multi-network in the European digital TV.

FIG. 2

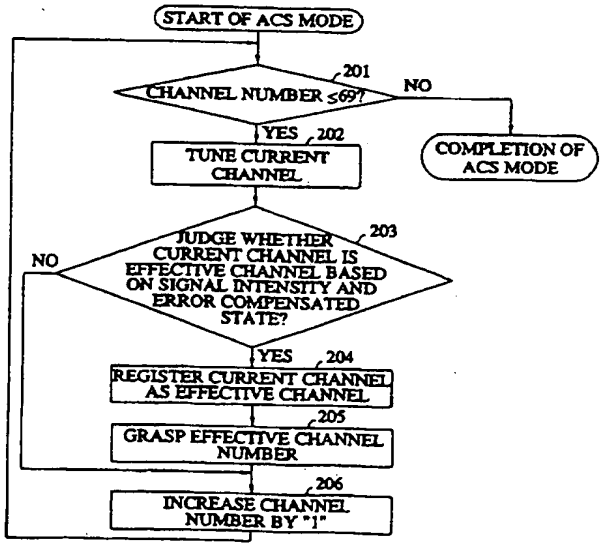

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FIG. 1

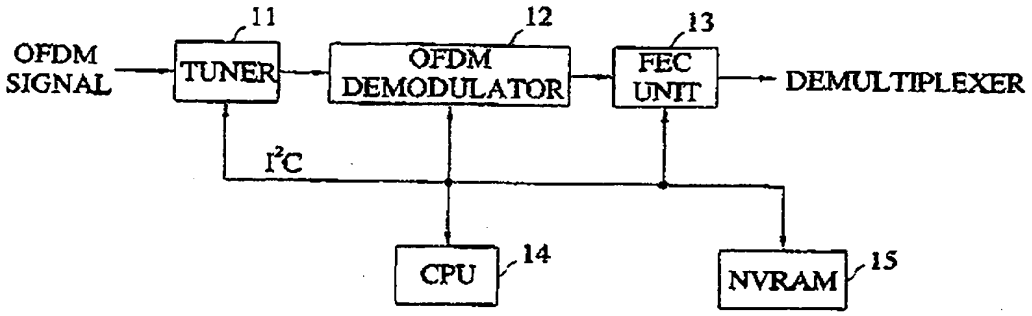
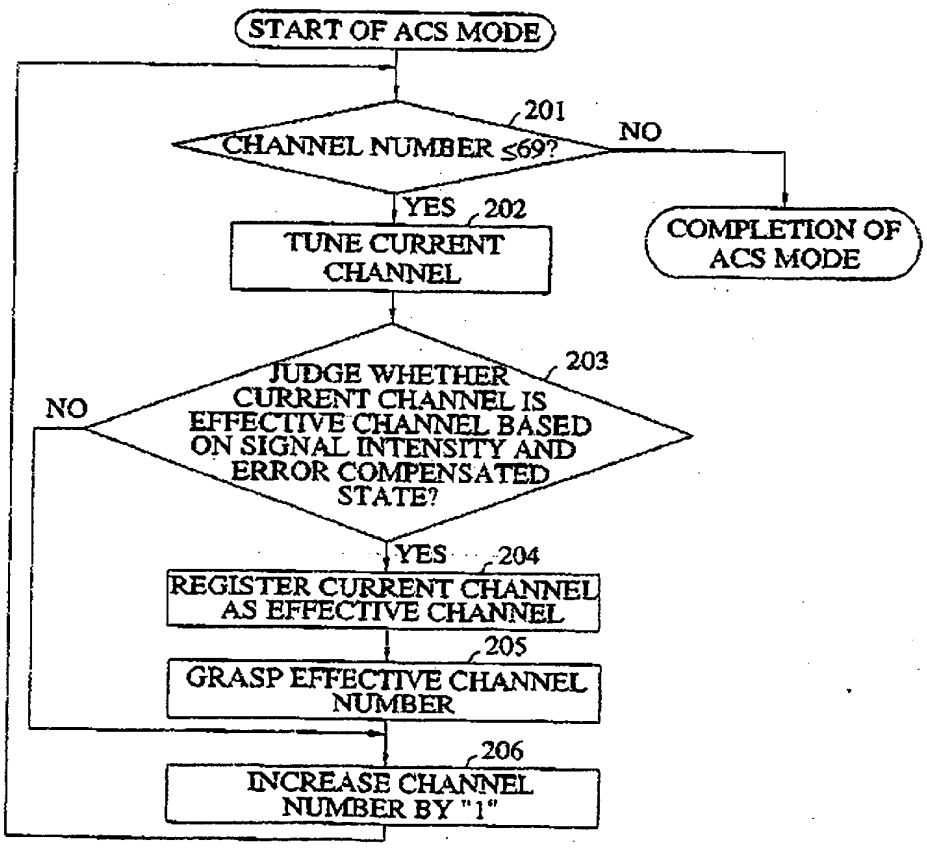

OFDM SIGNAL
11
TUNER
12
OFDM DEMODULATOR
13
FEC UNIT
DEMULTIPLEXER
I²C
CPU
14
NVRAM
15

FIG. 2


START OF ACS MODE
201
CHANNEL NUMBER ≤69?
NO
YES
202
TUNE CURRENT CHANNEL
COMPLETION OF ACS MODE
203
JUDGE WHETHER CURRENT CHANNEL IS EFFECTIVE CHANNEL BASED ON SIGNAL INTENSITY AND ERROR COMPENSATED STATE?
NO
YES
204
REGISTER CURRENT CHANNEL AS EFFECTIVE CHANNEL
205
GRASP EFFECTIVE CHANNEL NUMBER
206
INCREASE CHANNEL NUMBER BY "1"

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METHOD FOR AUTOMATICALLY SEARCHING CHANNELS IN DIGITAL BROADCASTING RECEIVER AND DIGITAL BROADCASTING RECEIVER ADOPTING THE SAME

The present invention relates to an automatic channel search for channel configuration of each network, and more particularly, to an automatic channel search method for automatically searching effective channels more reliably and stably and a digital broadcasting receiver performing the same.

When a broadcasting receiver such as a TV set is purchased and initially installed or removed, an automatic channel searching (ACS) mode should be performed for grasp of network status. When power is initially applied to the broadcasting receiver, or a user selects the ACS mode in the case that the broadcasting service area of the broadcasting receiver is altered, effective channels are found to perform channel configuration with respect to a network of a corresponding area of service.

As the number of channels increases due to start of digital broadcasting service, it is required that ACS mode should be more swiftly performed.

With a view to solve or reduce the above problems, it is an aim of embodiments of the present invention to provide a method for implementing an automatic channel searching (ACS) mode more swiftly and reliably in a digital broadcasting receiver for receiving a digital broadcasting to allow viewers to watch the digital broadcasting, and a digital broadcasting receiver adopting the same.

According to a first aspect of the present invention, there is provided an automatic channel searching (ACS) method for automatically searching channels in a digital broadcasting receiver, the ACS method comprising: (a) sequentially tuning the entire channels from the first channel to the last channel; (b) finding effective channels based on the intensity and the error compensated state of the signal tuned in step (a); (c) sequentially tuning the effective channels found in step (b) from the first effective channel to the last effective channel; and (d) parsing the signal tuned in step (c) to classify the tuned signal into various necessary information.

Preferably, said ACS is performed when said broadcasting receiver is initially installed or a user selects an ACS mode.

Preferably, said step (b) comprises the sub-steps of: (b1) demodulating and error correcting the signal of the tuned current channel, thereby obtaining an intensity of the signal; (b2) obtaining an average of the signal intensity obtained in step (b1); (b3) comparing the average of the signal intensity obtained in step (b2) with a reference value and judging whether the current channel is an effective channel in which a broadcasting signal exists based on the comparison result and the error compensated state via the error correction in step (b1); and (b4) registering the channel number whenever the current channel is judged as the effective channel, to then increase the frequency of the current channel.

Preferably, in said step (b3) the current channel is judged as an effective channel if the average of the

signal intensity exceeds the reference value and the signal is in the error compensated state.

In another aspect of the invention, there is also provided a digital broadcasting receiver comprising: a tuner for tuning an orthogonal frequency division multiplexing (OFDM) signal which is broadcast and received; an OFDM demodulator for demodulating the OFDM signal tuned in the tuner and obtaining intensity of the signal; a forward error correction (FEC) unit for error correcting the signal demodulated in the OFDM demodulator; a controller for controlling the tuner to sequentially tune the entire channel bands from the first channel and the last channels at the initial time when an automatic channel searching (ACS) mode is executed, and controlling the tuner to sequentially tune effective channels from the first effective channel to the last effective channel, in order to search the effective channels in which broadcasting signals exist, parse the searched effective channels and classify the parsed signal into various necessary information, based on the intensity of the signal obtained in the OFDM demodulator and the error compensated state in the FEC unit; and a memory unit for storing the effective channels searched in the controller.

Preferably, said memory unit pre-stores a particular value in a predefined address position for performance of an ACS mode, and wherein said controller judges whether or not an ACS mode is executed, on the basis of the value stored in the position indicated by a predefined address in said memory unit when power is turned on at the initial time of installation of a set or a user selects an ACS mode, and

alters the stored value at the time when the ACS mode is completed

For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings in which:

Figure 1 is a block diagram showing channel blocks of a digital TV to which an automatic channel search method according to an embodiment of the present invention is applied; and

Figure 2 is a flow chart for explaining an automatic channel search method according to the present invention.

A preferred embodiment of the present invention will be described with reference to the accompanying drawings.

Referring to Figure 1, a digital TV includes a tuner 11 for sequentially tuning the entire channel bands from the first channel to the last channel, and an orthogonal frequency division multiplexing (OFDM) demodulator 12 for demodulating an OFDM signal which has been tuned and input from the tuner 11. The OFDM demodulator 12 is designed using an LSI 64780 chip. The digital TV of Figure 1 also includes a forward error correction (FEC) unit 13 for error correcting the output of the OFDM demodulator 12, which is designed using an LSI 64724 chip and a memory unit 15 comprised of NVRAM (nonvolatile random access memory) for pre-storing particular values in positions corresponding to particular addresses for performance of an automatic channel searching (ACS) mode and storing

effective channels obtained after performance of the ACS mode. Meanwhile, the digital TV of Figure 1 also includes a central processing unit (CPU) 14 which is connected to each component block via an I^2C bus, for controlling the entire operations of each component block for performing the ACS mode. The CPU 14 finds effective channels based on the intensity of the tuned signal which is input via the OFDM demodulator 12 and the error compensated state of the FEC unit 13 and registers the found effective channels in the memory unit 15. The operation of performance of the ACS mode in a digital TV of Figure 1 having the above configuration will be described below with reference to Figure 2.

When a TV set is initially installed and power is turned on, or a user selects an ACS mode in the case that a broadcasting service area has been altered, the CPU 14 reads out a value stored in a corresponding position of the NVRAM 15 which is indicated by a predefined particular address. The CPU 14 judges whether or not an ACS mode will be performed based on the read value. For example, the CPU 14 performs the ACS mode in the case that the read value corresponding to the particular address is the same as that defined in the following Table 1.

Table 1

particular address	stored value
0X00	0XFF
0X40	0XFF
0X80	0XFF

For performance of the ACS mode, the CPU 14 controls the tuner 11 first, to allow the tuner 11 to sequentially tune the entire physical channel region from the first channel. In the British frequency channel bands 474MHz to 858MHz, sequential tuning is performed between the first channel which is channel 21 and the last channel which is channel 69, in which the frequency band is increased 8MHz by 8MHz from the first channel. The tuner 11 tunes a reception signal corresponding to channel 21 which is the first channel under the control of the CPU 14, and outputs the tune signal to the OFDM demodulator 12. The OFDM demodulator 12 demodulates the tuned signal into the prior-to-being-modulated signal using an orthogonal frequency division multiplexing (OFDM) method, and outputs the result to the FEC unit 13. The OFDM demodulator 12 designed using the LSI 64780 chip can obtain intensity of the tuned signal according to the chip characteristics. Thus, the CPU 14 can find out effective channels using the intensity of the tuned signal. The FEC unit 13 error corrects the OFDM demodulated signal output from the OFDM demodulator 12. The CPU 14 reads the intensity of the tuned signal obtained from the OFDM demodulator 12 by a predetermined number of times (here five times) and obtains an average thereof. The CPU 14 recognizes the tuned channel as an effective channel if the average of the signal intensities exceeds 40% and the error compensation has been performed in the FEC unit 13, and registers the effective channel in the NVRAM 15. The CPU 14 continues to tune the following channels and performs the same process, to thereby search effective channels. The above operation is performed up until channel 69 which is the last channel. In more detail, in the ACS mode start step, the CPU 14 judges whether a current channel

number is smaller than or equal to the last channel number "69" in order to judge if the entire channels are searched (step 201). If the current channel number is larger than the last channel number "69" in the result of the judgement of step 201, the CPU 14 judges that the entire channels have been searched and completes the ACS mode. Conversely, if the current channel number is smaller than or equal to the last channel number "69" in the result of the judgement of step 201, the CPU 14 judges that the entire channels have not been searched and controls the tuner 11 to tune the channel signal corresponding to the current channel number (step 202). When the tuner 11 tunes the corresponding channel signal in step 202, the CPU 14 judges whether the current channel is an effective channel in which a broadcasting signal exists (step 203). In step 203, the CPU 14 judges whether the current channel is an effective channel based on the average of the intensities of the tuned signal obtained in the OFDM demodulator 12 and the error compensated state in the FEC unit 13. That is, the CPU 14 judges that the current channel is an effective channel if the average of the signal intensities exceeds 40% and the error compensated state is formed in the FEC unit 13, that is, a lock is formed. If the current channel is the effective channel, the CPU 14 registers the current channel as the last channel in the NVRAM 15 (step 204). In this case, whenever the CPU 14 registers the current channel as the last channel, the CPU 14 increases the number of the effective channel by "1" to then grasp the effective channel number (step 205). Then, the current channel number is increased by "1" to alter the channel number (step 206), and repeatedly performs the steps from step 201 in order to search the effective channels from the

current channel up to the last channel. In step 203, if the current channel is not recognized as an effective channel, the CPU 14 repeatedly performs the steps from step 206 in order to find out the next effective channel.

The CPU 14 searches the entire channels, that is, from channel 21 to channel 69, and registers the found effective channels in the NVRAM 15, to then classify the effective channels into various information such as names of broadcasting stations and titles of programs. For this purpose, the CPU 14 controls the tuner 11 to tune a broadcasting signal corresponding to the first effective channel among the effective channels registered in the NVRAM 15. The OFDM signal corresponding to the broadcasting signal of the first effective channel tuned in the tuner 11 is demodulated in the OFDM demodulator 12 and then is error corrected in the FEC unit 13. The error compensated broadcasting signal is parsed via a demultiplexer which is the block following the FEC unit 13 and classified into various necessary information. When parsing is completed in the demultiplexer, the CPU 14 controls the tuner 11 to tune a broadcasting signal corresponding to the next effective channel so as to be parsed in the demultiplexer, and thus obtains the various necessary information. Such an operation is performed till the last effective channel.

When the ACS mode has been completely performed through the above processes, the CPU 14 alters all the values stored in the NVRAM 15 corresponding to the particular address into "0X00" and sets that the ACS mode has been performed.

As described above, the automatic channel search method and the digital broadcasting receiver according to the present invention searches the entire channels in the case that a set is initially installed or a broadcasting service area is changed, to find only effective channels via which broadcasting signal exist, and then parses various necessary information with respect to the found effective channels. Accordingly, a classification with respect to a multi-network can be carried out to thereby speedily process a channel configuration with respect to a single network.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extend to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS

1. An automatic channel searching (ACS) method for automatically searching channels in a digital broadcasting receiver, the ACS method comprising:

(a) sequentially turning the entire channels from the first channel to the last channel;

(b) finding effective channels based on the intensity and the error compensated state of the signal tuned in step (a);

(c) sequentially tuning the effective channels found in step (b) from the first effective channel to the last effective channel; and

(d) parsing the signal tuned in step (c) to classify the tuned signal into various necessary information.

2. The ACS method according to claim 1, wherein said ACS is performed when said broadcasting receiver is initially installed or a user selects an ACS mode.

3. The ACS method according to claim 1 or 2, wherein said step (b) comprises the sub-steps of:

(b1) demodulating and error correcting the signal of the tuned current channel, thereby obtaining an intensity of the signal;

(b2) obtaining an average of the signal intensity obtained in step (b1);

(b3) comparing the average of the signal intensity obtained in step (b2) with a reference value and judging whether the current channel is an effective channel in which a broadcasting signal exists based on the comparison result and the error compensated state via the error correction in step (b1); and

(b4) registering the channel number whenever the current channel is judged as the effective channel, to then increase the frequency of the current channel.

4. The ACS method according to claim 3, wherein in said step (b3) the current channel is judged as an effective channel if the average of the signal intensity exceeds the reference value and the signal is in the error compensated state.

5. A digital broadcasting receiver comprising:

a tuner for tuning an orthogonal frequency division multiplexing (OFDM) signal which is broadcast and received;

an OFDM demodulator for demodulating the OFDM signal tuned in the tuner and obtaining intensity of the signal;

a forward error correction (FEC) unit for error correcting the signal demodulated in the OFDM demodulator;

a controller for controlling the tuner to sequentially tune the entire channel bands from the first channel and the last channels at the initial time when an automatic

channel searching (ACS) mode is executed, and controlling the tuner to sequentially tune effective channels from the first effective channel to the last effective channel, in order to search the effective channels in which broadcasting signals exist, parse the searched effective channels and classify the parsed signal into various necessary information, based on the intensity of the signal obtained in the OFDM demodulator and the error compensated state in the FEC unit; and

a memory unit for storing the effective channels searched in the controller.

6. The digital broadcasting receiver according to claim 5, wherein said memory unit pre-stores a particular value in a predefined address position for performance of an ACS mode, and wherein said controller judges whether or not an ACS mode is executed, on the basis of the value stored in the position indicated by a predefined address in said memory unit when power is turned on at the initial time of installation of a set or a user selects an ACS mode, and alters the stored value at the time when the ACS mode is completed.

7. The digital broadcasting receiver according to claim 6, wherein said controller obtains an average with respect to the signal intensity of the current channel obtained in said OFDM demodulator, and recognizes that the current channel is an effective channel if the average exceeds a reference value and the signal is error compensated in said FEC unit to thereby register the current channel in said memory unit.

8. An automatic channel searching method (ACS) substantially as herein described with reference to Figures 1 and 2.

9. A digital broadcasting receiver, substantially as herein described with reference to Figures 1 and 2.